AF/2141
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TRANSMITTAL OF APPEAL BRIEF (Large Entity)

Docket No.
EN999121

In Re Application Of: **Scott T. Marcotte**

Application No.	Filing Date	Examiner	Customer No.	Group Art Unit	Confirmation No.
09/442,906	11/18/1999	Stephan F. Willett	23405	2141	6545

Invention: **METHOD, SYSTEM AND PROGRAM PRODUCTS FOR REDUCING DATA MOVEMENT WITHIN A COMPUTING ENVIRONMENT BY BYPASSING COPYING DATA BETWEEN FILE SYSTEM AND NON-FILE SYSTEM BUFFERS IN A SERVER**

COMMISSIONER FOR PATENTS:

Transmitted herewith in triplicate is the Appeal Brief in this application, with respect to the Notice of Appeal filed on

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☐ A check in the amount of the fee is enclosed.

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Dated: **June 8, 2004**

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Appellant:	Scott T. Marcotte	Group Art Unit:	2141
Serial No.:	09/442,906	Examiner:	Stephan F. Willett
Filed:	11/18/1999	Appeal No.:	

Title: METHOD, SYSTEM AND PROGRAM PRODUCTS FOR REDUCING DATA MOVEMENT WITHIN A COMPUTING ENVIRONMENT BY BYPASSING COPYING DATA BETWEEN FILE SYSTEM AND NON-FILE SYSTEM BUFFERS IN A SERVER

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Brief of Appellant

Dear Sir:

This is an appeal from a final rejection, dated January 12, 2004, rejecting claims 1-2, 9-11, 16-17, 24-26, 31-32, and 39-41, all the claims being considered in the above-identified application. This Brief is accompanied by a transmittal letter authorizing the charging of appellant's deposit account for payment of the requisite fee set forth in 37 C.F.R. §1.17(c).

EN999121

Real Party In Interest

This application is assigned to **International Business Machines Corporation** by virtue of an assignment executed on November 17, 1999 by the inventor, and recorded with the United States Patent and Trademark Office at reel 010438, frame 0184, on November 18, 1999. Therefore, the real party in interest is **International Business Machines Corporation**.

Related Appeals and Interferences

To the knowledge of the appellant, appellant's undersigned legal representative, and the assignee, there are no other appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in the instant appeal.

Status of Claims

This patent application was filed on November 18, 1999, with the U.S. Patent and Trademark Office. As originally filed, the application contained forty-five (45) claims, of which nine (9) were independent claims (i.e., claims 1, 12, 14, 16, 27, 29, 31, 42 & 44).

In an initial Office Action dated October 4, 2002, a new title was required and claims 1-45 were subject to restriction under 35 U.S.C. §121 between Group I (1-2, 9-11, 16-17, 24-26, 31-32, and 39-41); Group II (1-2, 9-11, 16-17, 24-26, 31-32, and 39-41); and Group III (7-8, 14-15, 22-23, 29-30, 37-38, and 44-45). Claims 1-2, 9-11, 16-17, 24-26, 31-32, and 39-41 of Group I were provisionally elected with traverse by telephone by appellant's representative, Blanche Schiller, on September 6, 2002. The provisionally elected claims of Group I were rejected under 35 U.S.C. §103(a) as being unpatentable over appellant's admitted prior art in view of Ledain et al (U.S. Patent No. 6,021,408; herein after Ledain); and Hamilton et al. (U.S. Patent No. 5,799,150; hereinafter

Hamilton). In appellant's response mailed February 4, 2003, a new title was provided, and claims 1, 16 & 31 were amended, election of claims 1-2, 9-11, 16-17, 24-26, 31-32, and 39-41 was confirmed, and the restriction requirement was traversed.

In a final Office Action dated March 13, 2003, the restriction requirement was deemed proper; independent claims 1, 16 and 31 were rejected under 35 U.S.C. §112, first paragraph, as containing subject matter not described in the specification; claims 1, 16 and 31 were rejected under 35 U.S.C. §103(a) as being obvious over appellant's admitted prior art in view of Burnett et al. (U.S. Patent No. 6,006,018; hereinafter Burnett) and Cox et al. (U.S. Patent No. 5,539,757); while claims 1-2, 9-11, 16-17, 24-26, 31-32 and 39-41 were rejected as obvious over appellant's admitted prior art in view of Ledain and Hamilton. In appellant's response mailed June 2, 2003, claims 1, 16 and 31 were amended and claims 3-8, 12-15, 18-23, 27-30, 33-38 and 42-45 were cancelled.

In an Advisory Action dated June 18, 2003, appellant's response was considered, however appellant's amendments were not entered on grounds that the amendments raised new issues requiring a new search. In response, appellant filed a Request for Continued Examination on July 8, 2003 (with a petition for one month extension of time) which requested consideration of the amendments submitted June 2, 2003.

In an Office Action dated August 20, 2003, independent claims 1, 16 & 31 were rejected under 35 U.S.C. §112, first paragraph, as containing subject matter not described in the specification; and claims 1, 2, 9-11, 16, 17, 24-26, 31, 32, and 39-41 were rejected under 35 U.S.C. §103(a) as being obvious over appellant's admitted prior art in view of Burnett and Hamilton, and were rejected under 35 U.S.C. §103(a) as being obvious over appellant's admitted prior art in view of Ledain and Hamilton. In appellant's response mailed November 18, 2003, claims 1, 16 and 31 were amended.

In a final Office Action dated January 12, 2004, independent claims 1, 16 & 31 were rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which appellant regards as the invention; and claims 1-2, 9-11, 16-17, 24-26, 31-32 and 39-41 were rejected under 35 U.S.C. §103(a) as being obvious over Burnett in view of Hamilton; and were rejected under 35 U.S.C. §103(a) as being obvious over appellant's admitted prior art in view of Ledain and Hamilton. In appellant's response mailed March 8, 2004, no claims were amended.

In an Advisory Action dated March 18, 2004, appellant's response was considered, however, the grounds of rejection were maintained. A Notice of Appeal to the Board of Patent Appeals and Interferences was filed on April 9, 2004. The status of the pending claims is therefore as follows:

Allowed claims - none
Claims objected to - none
Claims rejected - 1, 2, 9-11, 16, 17, 24-26, 31, 32, and 39-41
Claims canceled - 3-8, 12-15, 18-23, 27-30, 33-38 and 42-45.

Appellant is appealing the rejection of claims 1, 2, 9-11, 16, 17, 24-26, 31, 32, & 39-41.

Status of Amendments

Appellant proffered no amendments responsive to the final Office Action dated March 8, 2004. The claims as set out in the Appendix include all prior entered claim amendments.

Summary of the Invention

Appellant recites a technique (e.g., claims 1, 16 and 31) for reducing data movement within a computing environment 100 (FIG. 1). The technique includes

transmitting data between a file system of a server 102 of the computing environment and a transmission medium of the computing environment, the transmitting being responsive to a request for transmission received by the server. (See Specification pages 8-10.) The server includes at least one file system buffer and at least one server buffer residing outside the file system of the server. The data transmission includes at least one of: (1) receiving the data by the file system from a sender, wherein the receiving includes swapping one or more buffers of the at least one file system buffer with the one or more buffers of the at least one server buffer (see FIGs. 10A & 10B and Specification pages 28-32); and (2) sending the data from the file system over the transmission medium to a receiver of the data, wherein the sending includes executing, by the file system, a callback function referenced by the request to send the data directly over the transmission medium from the one or more buffers of the at least one file system buffer (see FIGs. 9A & 9B and Specification pages 25-28). The swapping and the executing of the callback function reduce data movement in the server by bypassing copying of the data between one or more buffers of the server and one or more buffers of the file system in performing the transmission. The bypassing copying of the data is without the server having advanced notice of a pattern of access of the data in the file system (see Specification pages 37-38).

Issues

1. Whether claims 1, 16 & 31 are indefinite for failing to particularly point out and distinctly claim the subject matter which appellant regards as the invention and, therefore, properly rejected under 35 U.S.C. §112, second paragraph.

2. Whether claims 1, 2, 9-11, 16, 17, 24-26, 31, 32, & 39-41 were rendered obvious under 35 U.S.C. 103(a) to one of ordinary skill in the art by Burnett in view of Hamilton.

3. Whether claims 1, 2, 9-11, 16, 17, 24-26, 31, 32, & 39-41 were rendered obvious under 35 U.S.C. 103(a) to one of ordinary skill in the art based by appellant's admitted prior art in view of Ledain and further in view of Hamilton.

Grouping of Claims

Since each ground of rejection provides a group of claims, the following group of claims is included herein:

I. Claims 1, 2, 9-11, 16, 17, 24-26, 31, 32, & 39-41.

Appellant respectfully submits that the claims of Group I stand or fall together.

Argument

Claims 1, 2, 9-11, 16, 17, 24-26, 31, 32, & 39-41

35 U.S.C. §112:

As noted, claims 1, 16 & 31 stand rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which appellant regards as the present invention. Reversal of this rejection is respectfully requested.

The final Office Action objected to appellant's recited characterization in claims 1, 16 & 31 that "wherein said swapping and said executing the callback function facilitate reducing data movement in said server by bypassing copying of the data between one or more buffers of the at least one server buffer and the one or more buffers of the at least one file system buffer ...". Appellant respectfully submits that this wherein statement in the independent claims further characterizes both the swapping function and the

executing of the callback function. In both the swapping and the executing, reduction in data movement is accomplished by bypassing copying of data between the specific buffers recited. That is, the wherein statement further expresses the result of the at least one of the swapping and the executing of the callback function recited earlier in the claim. In view of this, reversal of the indefiniteness rejection is requested.

Appellant claims "transmitting data between a file system of a server of the computing environment and a transmission medium." Appellant respectfully submits that the word "data" can be read in plural form, with the phrase "transmitting data" read to include transmitting one or more units of data. This transmitting can thus be accomplished as either a read operation, a write operation, or both read and write operations for different portions of data within the data being transmitted. In accordance with appellant's independent claims, the transmitting includes at least one of receiving the data by the file system from a sender, with the receiving including swapping one or more buffers of the at least one file system buffer with one or more buffers of the at least one server buffer, and sending the data from the file system over the transmission medium to a receiver of the data, the sending including executing, by the file system, a callback function referenced by the request to send the data directly over the transmission medium from the one or more buffers of the at least one file system buffer.

In the case of receiving data, the file system is receiving data from over the transmission medium, and thus, receiving the data including swapping the buffers would be read by one of ordinary skill in the art to be accomplished during a write operation. Similarly, the sending of data from the file system over the transmission medium to a receiver, would be read by one of ordinary skill in the art to be accomplished in conjunction with a read operation. Thus, because data is plural, appellant recites novel functionality for moving data in conjunction with receiving the data (during a write operation) or sending the data (during a read operation). The independent claims recite functionality for moving data in both directions depending upon whether data is being

moved from the transmission medium to the file system or from the file system to the transmission medium.

Additionally, Appellant respectfully traverses the characterization that the server can be the "sender" or the "receiver". In the independent claims, functionality is recited for transmitting data between a file system of a server and a transmission medium. The file system is recited to be "of a server of the computing environment". Thus, in Appellant's claims, data moves between the file system of the server and a transmission medium of the computing environment, with the sender and the receiver communicating over the transmission medium.

To summarize, the independent claims are believed to particularly point out and distinctly claim the subject matter which appellant regards as the present invention. This is particularly true when read by one of ordinary skill in the art and in light of appellant's specification. The "data" recited by appellant is a plural form of the word meaning that transmitting can occur for multiple pieces of data, and meaning that different pieces of data may be read, while others written. Thus, appellant's transmitting is recited to include "at least one of" functionality for receiving data by the file system (i.e., during a write function) and sending the data from the file system over the transmission medium to a receiver (i.e., during a read operation). For all of the above reasons, appellant respectfully requests reversal of the 35 U.S.C. §112, second paragraph, rejection to independent claims 1, 16, & 31.

35 U.S.C. §103(a)

As noted, claims 1, 2, 9-11, 16, 17, 24-26, 31, 32 & 39-41 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Burnett in view of Hamilton; and as being unpatentable over appellant's admitted prior art in the background in view of Ledain and Hamilton. Reversal of these rejections is respectfully requested.

Appellant's invention recites, in part, swapping file system buffers with server buffers (e.g., during a write operation) or executing a callback function to send data

directly over the transmission medium from file system buffers (e.g., during a read operation) to facilitate reducing data movement in the server by bypassing the copying of data between file system buffers and the server buffers. Further, the copying of data is bypassed without the server having advance notice of a pattern of access of the data in the file system. Advantageously, this avoidance of data copying between the server and file system buffers reduces data movement in the server and enhances response time. Appellant respectfully submits that at least these features of the claimed invention are not taught, suggested or implied by Burnett, Hamilton, appellant's admitted prior art, or Ledain, either alone or in combination.

Burnett/Hamilton:

Burnett discloses a Distributed File System (DFS) translator technique that provides authenticated access to files stored in a target distributed system in response to requests from clients in a source distributed file system. The technique includes mapping credentials associated with the request into enhanced credentials that include authentication information (see Abstract thereof). In Burnett, a remote access of a file occurs through a two-step caching process whereby a server node retrieves the file and stores it in a server cache, and a client node goes out over the network, retrieves the file and stores it in a client cache (see FIG. 1; col. 4, lines 44-66). This is very different from the data transmission's functionality and the bypassing of the copying of data recited by Appellant.

For example, appellant recites transmitting data between a file system of a server and a transmission medium that includes at least one of receiving the data by the file system from a sender and sending the data from the file system over the transmission medium to a receiver. Again, the transmitting is responsive to a request for transmission received by the server. The receiving includes swapping one or more file system buffers with one or more server buffers. For example, during processing an operation that writes data to a disk coupled to the file system of the server, the data is sent from a sender (e.g., a client) and a write routine is called (e.g., pfs_write) with pointers to server buffers that

are compatible with file system buffers (e.g., the server buffers have page aligned offsets that conform to the page alignments of the file system buffers). In this example, instead of data being stored in the server buffers and then copied (i.e., moved) to the file system buffers, the copy is avoided (i.e., bypassed) by swapping the file system buffers with the server buffers. That is, the pointers to the server buffers are switched to the file system buffers (see, e.g., page 29, line 1 – page 30, line 11 and 1030 of FIG. 10B of the specification).

As another example, during processing of a read operation, a read routine is called (e.g., pfs_read) with input that includes a pointer to a callback function. The file system then executes the callback function with the addresses of the file system buffers that contain the data being read. In this example, the execution of the callback function allows the data to be sent directly (e.g., without being copied to server buffers) from the file system buffers over the transmission medium to a receiver (e.g., a client) (see, e.g., p. 25, line 15 – p. 26, line 5 and 922 of FIG. 9B).

In contrast, the description of buffers in Burnett does not teach or suggest the above-described functionalities of data transmission (i.e., buffer swapping and callback function execution) for reducing data movement in a server by bypassing data copying between server buffers and file system buffers of the server. Instead, Burnett discloses client buffers that allow access to remote files (i.e., files residing on the server) to reduce network traffic and overhead (col. 4, line 64 – col. 5, line 2) without describing or suggesting the buffer swapping or callback function execution functionalities recited by the present invention.

Further, the bypassing of copying between the server buffers and file system buffers in the present invention is accomplished without the server having advance notice of a pattern of access of the data in the file system. For example, without knowing what data is to be accessed by future requests, data movement can still be reduced in the server by the above-noted bypassing of copying.

In contrast, the server in Burnett having or not having advance notice of a pattern of access of data in a file system is simply not discussed. For example, the advantageous reduction of network traffic and overhead in Burnett is not associated with the server having (or not having) such advance notice. Instead, this advantage of Burnett is associated with a client node storing blocks of a remote file into a client cache, as the remote file existed in a server cache (col. 4, lines 60-63).

The Office Action cites col. 5, lines 4-7 & 26-27; col. 4, lines 44-45, 49-60 & 65-66; and col. 5, line 61 – col. 6, line 27 of Burnett in support of the rejection. These sections describe data transmissions of read and write operations, as well as clients and servers and their associated caches. Appellant respectfully submits that the data transmissions described therein do not teach or suggest the above-noted functionalities of the data transmission recited in the claims presented herewith. For example, col. 4, lines 65-66 discusses an access of data in a client cache instead of going across the network to access the server without describing or suggesting the buffer swapping or callback function execution functionalities of the server recited by the present invention.

Hamilton does not overcome the deficiencies of Burnett as applied to appellant's claimed invention. Hamilton describes a distributed multimedia system which enables real-time transmission of broadcast quality media data over a network (col. 3, lines 38-40 thereof). Prior to a server receiving a client's request to read media data, the Hamilton technique creates and populates a TrackList data structure residing on the server to store the media data that the client will need (col. 6, lines 32-36; col. 7, lines 6-10). The TrackList also allows the server to perform read ahead operations to satisfy subsequent read requests (col. 7, lines 21-28). Processing these read requests results in, for example, audio/video playback wherein data is transmitted directly to "user level" memory buffers of the client (col. 6, lines 5-7; col. 10, lines 3-6). This playback scheme is very different from appellant's recited invention.

For example, as noted above, appellant's invention recites, in part, transmitting data that includes swapping file system buffers with server buffers or executing a

callback function to send data directly over the transmission medium from the file system buffers, wherein the swapping and the executing of the callback function each facilitate reducing data movement in the server. As described above, this data movement reduction is accomplished by bypassing copying the data between server buffers and file system buffers of the server.

In contrast, Hamilton fails to teach or suggest such functionalities of a data transmission, let alone such functionalities used to facilitate reducing data movement in a server by bypassing data copying between the above-described buffers. When the Hamilton technique directly transmits media data to a user level memory buffer, it bypasses copying media data to system memory buffers (col. 6, lines 3-7; col. 9, lines 57-67). However, this buffer copying avoidance is quite different from the bypassing of copying data between the buffers recited in the present invention. In Hamilton, the bypassed system memory buffers are not the result of data transmission that includes buffer swapping or the execution of a callback function. Further, the bypassed system memory buffers reside on the client side (col. 6, lines 6-7). The bypassed non-file system buffers of appellant's claimed invention reside on the server (see, e.g., claim 1). Moreover, since the buffer bypassing in Hamilton occurs at the client, the resulting data movement reduction is also limited to the client side (Abstract; col. 6, lines 3-7). Appellant's invention, on the other hand, recites reducing data movement in the server.

Further, Hamilton fails to teach or suggest the bypassing of copying data between server buffers and file system buffers of a server, without the server having advance notice of a pattern of access of the data in the file system. Hamilton's playback data transmission results from the server using the predictive information of the TrackList to perform read aheads to satisfy current and subsequent client read requests (col. 7, lines 19-28). Thus, Hamilton relies on the server having advance notice of the pattern of data access determined by the client's read requests.

In addition, the bypassed system memory buffers reside on the client side in Hamilton. In Hamilton, the client knows that a reply from the server is coming and the

client uses that knowledge to avoid a buffer move. Thus, because the buffer bypassing function taught by Hamilton requires advance knowledge by the client and the server, and because the bypassing occurs at the client, appellant respectfully submits that Hamilton does not teach or suggest bypassing copying data between server and file system buffers without the server having advance notice of a pattern of access of the data in the file system as recited in the independent claims.

In the Office Action, col. 9, lines 59-67 and col. 10, lines 2-6 & 34-39 are cited as teaching bypassing non-file system buffers. The referenced sections describe bypassing system memory buffers, but the related discussion indicates that these buffers are bypassed in the client rather than the server (see also col. 10, lines 3-6 and FIG. 7 of Hamilton). Thus, this section of Hamilton does not teach or suggest reducing data movement on a server by bypassing the copying of data between server buffers and file system buffers of the server, as recited by the claims.

Based on the foregoing, Burnett and Hamilton each fail to teach or suggest multiple features recited by appellant. For example, the applied art does not teach or suggest transmitting data including the functionalities of swapping buffers or executing a callback function, wherein these functionalities reduce data movement in the server by bypassing copying the data between server buffers and file system buffers. As another example, the applied art fails to teach or suggest bypassing the copying of the data without the server having advance notice of a pattern of access of the data in the file system. Thus, appellant respectfully submits that the combination of Burnett and Hamilton also fails to teach or suggest appellant's claimed invention.

For the above reasons, appellant respectfully requests reversal of the obviousness rejection to the claims of Group I based on Burnett in view of Hamilton.

Appellant's Background Art/ Ledain/ Hamilton

The above-summarized features of appellant's independent claims are discussed above relative to Hamilton. Therefore, the following remarks focus on the deficiencies of appellant's Background Art and Ledain relative to the pending claims.

Appellant's Background Art describes a Distributed File Services (DFS) system, in which data is moved from one set of buffers within the server to another set of buffers within the server. These data movements increase processing time at the server, thereby negatively affecting response time of requests (e.g., read and write requests) (see appellant's specification at page 2, lines 12-19). This data movement (i.e., copying) between sets of buffers within the server that is present in the prior art is expressly avoided (i.e., bypassed) in the present invention (see, e.g., claim 1). Thus, the background art does not teach or suggest a technique for bypassing the copying of data between server buffers and file system buffers. Moreover, appellant respectfully submits that the background art does not describe or suggest a scheme for transmitting data between a file system of a server and a transmission medium that includes at least one of the above-described swapping and callback function executing, reducing data movement in a server by bypassing the above-noted copying, or for bypassing such copying without the server having advance notice of a pattern of access of the data in the file system. These features lacking in the background art are also not taught, suggested or implied by Ledain or Hamilton.

Ledain describes a log-structured file system including a disk with the main file system and multiple log disks. File write operations store file and system data to the log disks rather than to the main file system. A control program in Ledain manages the migration of the previously written data from the log disks to the main file system (see Abstract and col. 5, lines 36-61 thereof). Thus, Ledain's technique improves file writing speed at the expense of extra disk space. Appellant respectfully submits that Ledain's subject matter is quite different from the recited invention.

For example, the data transmission of the recited invention includes at least one of the above-noted buffer swapping and the execution of the callback function. Not only is Ledain silent as to these recited functionalities of the transmission of the data, but Ledain also fails to teach or suggest such functionalities to facilitate reducing data movement in the server, or reducing data movement by bypassing copying the data between server buffers and file system buffers. Instead, Ledain is directed to avoiding writing to a file system disk.

Further, appellant's invention recites that the copying of data is bypassed without the server having advance notice of a pattern of access of the data. The Office Action cites col. 9, lines 25-29 and col. 8, lines 23-26 of Ledain as teaching routing of data through buffers without knowledge. These sections of Ledain address data passing to a buffer for temporary storage and describe log disk data that allows for storage of file and system data within a file system (see also Abstract thereof). Appellant respectfully submits that the existence of log disk data implies a storage mechanism without any suggestion of a server having no advance notice of a pattern of data access. Thus, it is respectfully submitted that Ledain does not teach or suggest copying the data being bypassed without the server having advance notice of a pattern of access of the data in the file system. Further, Ledain does not describe or suggest bypassing server buffers, nor bypassing such buffers for the purpose of reducing data movement in the server.

As noted, the distinguishing features of appellant's independent claims are discussed above with respect to Hamilton relative to the rejection thereof based on Burnett in view of Hamilton. Those comments also apply to the rejection of the claims of Group I based on appellant's Background Art in view of Ledain and in view of Hamilton.

For all of the above reasons, appellant respectfully requests reversal of the obviousness rejections to the claims of Group I based on appellant's Background Art, Ledain and Hamilton.

Conclusion

Appellant herein requests reversal of the 35 U.S.C. §112, second paragraph, rejection of independent claims 1, 16 & 31 as set forth in the final Office Action. Appellant respectfully submits that the claims presented particularly point out and distinctly claim the subject matter which appellant regards as the present invention.

Appellant further requests reversal of the 35 U.S.C. §103 rejections of claims 1, 2, 9-11, 16, 17, 24-26, 31, 32 & 39-41 as set forth in the Office Action. The art does not, individually or in combination, teach or imply appellant's recited invention which includes, in part, swapping file system buffers with server buffers (e.g., during a write operation) or executing a callback function to send data directly over the transmission medium from file system buffers (e.g., during a read operation) to facilitate reducing data movement in the server by bypassing the copying of data between file system buffers and the server buffers. Further, the copying of data is bypassed without the server having advance notice of a pattern of access of the data in the file system.

For the above reasons, appellant alleges error in rejecting the recited invention as obvious based on the applied art. Accordingly, reversal of all rejections is respectfully requested.

Respectfully submitted,

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Dated: June 8, 2004

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Appendix

1. A method of reducing data movement within a computing environment, said method comprising:

transmitting data between a file system of a server of said computing environment and a transmission medium of said computing environment, said transmitting being responsive to a request for transmission received by the server, wherein said server includes at least one file system buffer and at least one server buffer, said at least one server buffer residing outside the file system of the server,

wherein said transmitting comprises at least one of:

receiving said data by said file system from a sender, said receiving comprising swapping one or more buffers of the at least one file system buffer with said one or more buffers of the at least one server buffer; and

sending said data from said file system over said transmission medium to a receiver of said data, said sending comprising executing, by the file system, a callback function referenced by said request to send said data directly over the transmission medium from the one or more buffers of the at least one file system buffer, and

wherein said swapping and said executing the callback function facilitate reducing data movement in said server by bypassing copying the data between one or more buffers of the at least one server buffer and the one or more buffers of the at least one file system buffer in performing the transmission, said copying the data being bypassed without the server having advance notice of a pattern of access of the data in the file system.

2. The method of claim 1, wherein said transmitting comprises sending data from a sender of said computing environment over said transmission medium to said file system to be written to one or more storage media coupled to said file system.

9. The method of claim 1, wherein said transmitting comprises sending data from said file system over said transmission medium to a receiver of said data.

10. The method of claim 9, wherein said sending comprises using a routine identified by said receiver to send said data, wherein said routine is provided one or more pointers to said data to be sent to said receiver.

11. The method of claim 9, wherein said sending comprises providing to said receiver one or more pointers to said data.

16. A system of reducing data movement within a computing environment, said system comprising:

means for transmitting data between a file system of a server of said computing environment and a transmission medium of said computing environment, said transmitting being responsive to a request for transmission received by the server, wherein said server includes at least one file system buffer and at least one server buffer, said at least one server buffer residing outside the file system of the server,

wherein said means for transmitting comprises at least one of:

means for receiving said data by said file system from a sender, said means for receiving comprising means for swapping one or more buffers of the at least one file system buffer with said one or more buffers of the at least one server buffer; and

means for sending said data from said file system over said transmission medium to a receiver of said data, said means for sending comprising means for executing, by the file system, a callback function referenced by said request to send said data directly over the transmission medium from the one or more buffers of the at least one file system buffer, and

wherein said means for swapping and said means for executing the callback function facilitate reducing data movement in said server by bypassing copying the data between one or more buffers of the at least one server non-file system buffer and the one or more buffers of the at least one file system buffer in performing the transmission, said copying the data being bypassed without the server having advance notice of a pattern of access of the data in the file system.

17. The system of claim 16, wherein said means for transmitting comprises means for sending data from a sender of said computing environment over said transmission medium to said file system to be written to one or more storage media coupled to said file system.

24. The system of claim 16, wherein said means for transmitting comprises means for sending data from said file system over said transmission medium to a receiver of said data.

25. The system of claim 24, wherein said means for sending comprises means for using a routine identified by said receiver to send said data, wherein said routine is provided one or more pointers to said data to be sent to said receiver.

26. The system of claim 24, wherein said means for sending comprises means for providing to said receiver one or more pointers to said data.

31. At least one program storage device readable by a machine, tangibly embodying at least one program of instructions executable by the machine to perform a method of reducing data movement within a computing environment, said method comprising:

transmitting data between a file system of a server of said computing environment and a transmission medium of said computing environment, said transmitting being responsive to a request for transmission received by the server, wherein said server includes at least one file system buffer and at least one server buffer, said at least one server buffer residing outside the file system of the server,

wherein said transmitting comprises at least one of:

receiving said data by said file system from a sender, said receiving comprising swapping one or more buffers of the at least one file system buffer with said one or more buffers of the at least one server buffer; and

sending said data from said file system over said transmission medium to a receiver of said data, said sending comprising executing, by the file system, a callback function referenced by said request to send said data directly over the transmission medium from the one or more buffers of the at least one file system buffer, and

wherein said swapping and said executing the callback function facilitate reducing data movement in said server by bypassing copying the data between one or more buffers of the at least one server non-file system buffer and the one or more buffers of the at least one file system buffer in performing the transmission, said copying the data being bypassed without the server having advance notice of a pattern of access of data in the file system.

32. The at least one program storage device of claim 31, wherein said transmitting comprises sending data from a sender of said computing environment over said transmission medium to said file system to be written to one or more storage media coupled to said file system.

39. The at least one program storage device of claim 31, wherein said transmitting comprises sending data from said file system over said transmission medium to a receiver of said data.

40. The at least one program storage device of claim 39, wherein said sending comprises using a routine identified by said receiver to send said data, wherein said routine is provided one or more pointers to said data to be sent to said receiver.

41. The at least one program storage device of claim 39, wherein said sending comprises providing to said receiver one or more pointers to said data.

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